

ABSTRACT OF THE DISCLOSURE

A device is provided that can capture and store electrically neutral excited species of antimatter or exotic matter (a mixture of antimatter and ordinary matter), in particular, excited positronium (Ps^*). The antimatter trap comprises a three-dimensional or two-dimensional photonic bandgap (PBG) structure containing at least one cavity therein. The species are stored in the cavity or in an array of cavities. The PBG structure blocks premature annihilation of the excited species by preventing decays to the ground state and by blocking the pickoff process. A Bose-Einstein Condensate form of Ps^* can be used to increase the storage density. The long lifetime and high storage density achievable in this device offer utility in several fields, including medicine, materials testing, rocket motors, high power/high energy density storage, gamma-ray lasers, and as an ignition device for initiating nuclear fusion reactions in power plant reactors or hybrid rocket propulsion systems.